EDUCATE ACT THRIVE

FOR THE IMMUNE SYSTEM

EE Zhang

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CONTENTS

PREFACE

Trying to use modern medicine to cure diseases is like trying to develop a new type of gun in our planetary defense system for every new alien that comes by. That will be an infinite number of different guns we have to keep on inventing. People want a quick fix but there is none. Instead, we should focus on supporting our already existing super versatile weapon—our immune system; it is our one weapon that can fend off any and all types of "aliens."

The immune system detects and kills foreign invaders and diseased cells. It is far more powerful than any medication scientists have created. It is one of the greatest mysteries of the human body, and is also one of the human body's most important components.

Supporting and improving our one and only superweapon is not fancy or thrilling. It is not glamorous, and it is not headline worthy. Sometimes, it is plain boring. But it is effective.

Simply improving our immune system superweapon is easier and more effective than trying to search for medicines or develop new medicines that can fight the constantly evolving viruses and bacteria.

We just need to eat more wholesome plant foods.

Preventing Diseases with a Healthy Immune System

Prevention does not receive as much limelight as a cure. People often feel like a cure is more important or effective because the results are very clear. Prevention is not an exact science, and watching someone never get a disease to begin with is just not as exciting. People tend to wait until a problem arises before trying to find ways to fix it. But we do not want problems to begin with. Otherwise, it is a perpetual game of cat and mouse.

Prevention is simple.

- Eat healthy.
- Exercise more.
- Get adequate rest.
- Be happy.

Our big natural world contains all the wholesome foods with all the nutrients that we need, plus more that scientists have not discovered yet.

Eat Healthy

We may not be able to control new viruses from emerging or prevent carcinogenic compounds in the air, but we can control what we eat. Everyone knows that if we eat healthy, we live longer and healthier. The impact of improving our diet can be huge.

Nutritional Immunology is simple and time-proven. Eat a variety of wholesome plant foods and less animal products to benefit every system in our body. There is no point eating certain foods to target the health of one particular organ because all of our organs are connected. If one organ fails, it will drag the others along with it. For example, focusing on our heart health means nothing if our kidneys are unhealthy because unhealthy kidneys will affect our heart. Hence, the best diet includes a variety of plant foods. In that way, we get a variety of nutrients that help all of our organs.

Changing our diet to include more wholesome plant foods may be difficult to maintain, but it is one of the best things we can do to support our immune system in fighting off invaders and keeping us healthy.

Exercise More

Exercising has many benefits:

- Controls our weight and reduces the risk of diseases linked to obesity
- Reduces risk of heart disease
- Manages blood sugar and insulin levels and cuts down the risk of type 2 diabetes
- Helps keep cognitive abilities sharp
- Strengthens bones and muscles
- Reduces risk of cancers, such as breast, colon, and lung cancers
- Reduces risk of falls
- Improves sleep

We, as human beings, are not made to be couch potatoes, but we also do not need to do extreme or intense exercise. Every day, make it a goal to get up and walk more. It is all about the mindset—no one needs to jump right into it. Baby steps are perfectly fine. The important thing is to get moving.

Get Adequate Rest

Lack of adequate rest can adversely affect the immune system. Studies show that people who do not get enough sleep, or enough quality sleep, are more likely to fall prey to infections. They also recover slower. Long-term lack of quality sleep increases the risk of disease, such as heart disease, obesity, and type 2 diabetes.

Be Happy

Last but not least—happiness. Our mental state is intrinsically linked to our immune system. Some research shows that our mood can affect our well-being. In a study involving patients with breast cancer, researchers found that those who had better stress management had downregulation of gene expression in cells associated with inflammation and metastasis. Mood matters—it can affect our psychological and physiological states.

Make Your Choice

Would you rather focus on prevention or roll the dice with a cure?

The cost of a cure is a roll of the dice. Will you even be cured? Most diseases are not cured; they are "managed." In other words, they never go away. What sort of long-term complications will you get from all the medications? Were those extra meals of junk food, those extra nights you spent lying on the couch, really worth the pain and suffering from an illness?

The cost of prevention is simple. Give up junk food. Instead of taking a taxi, take a walk. Choose to go to bed instead of staying up to watch the new TV episode.

Your everyday choices add up. Choose wisely.

Arm Yourself with Nutritional Immunology

This is what Nutritional Immunology is all about. It is about having the knowledge to know what the costs and benefits are. It is about taking responsibility for your own health. It is about picking the right foods to eat to support your immune system. It is about changing your lifestyle because you know that health is more than what you eat. It is about understanding that practicing prevention is always better than seeking a cure. It is about having the wisdom to know what price you would rather pay.

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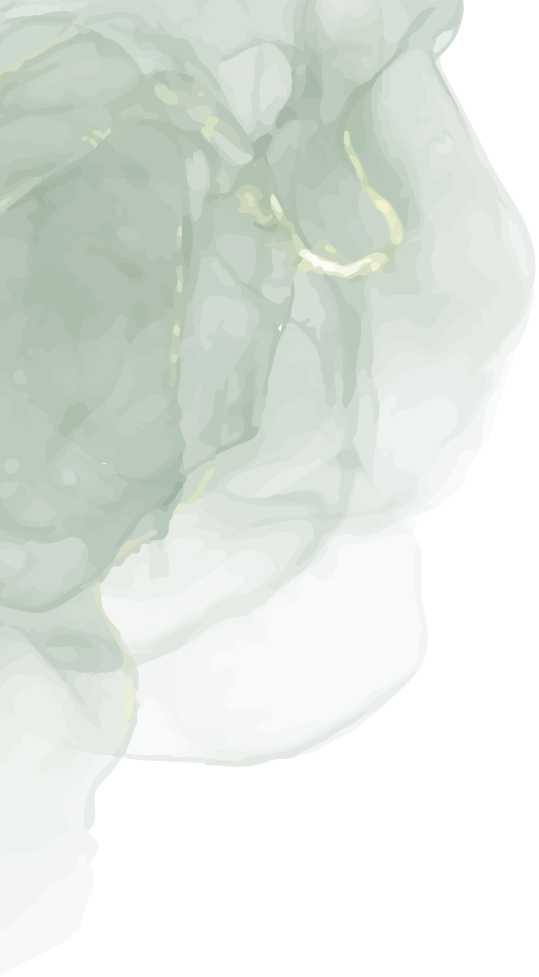


EDITOR'S NOTE

We want to bring you a book that breaks the barrier between scientific research and public knowledge. Much of what many of us know about our health comes from two places:

- that dusty little area in our brain where we crammed away soon-to-be forgotten tidbits of information the night before that high school biology exam
- that questionable-source-first-link-ad-supported-webpage during our quick search on all health-related inquiries

Suffice to say, we do not think that is enough, given how important our health is, and how it permeates practically every aspect of our lives. Unfortunately, most health information and much of the new research and development is too difficult to understand. We would like to remedy that and carry knowledge out of those mysterious depths and into the light of day.

We hope this book can help you uncover the truths about health and nutrition. They are presented in a way that is comfortable and digestible so that the book will not finish its life collecting digital dust (or real dust on your shelf). We have a lofty mission to touch lives: to share the gifts of health and knowledge with mankind. Our only hope is that this book represents a worthy step along that journey.

Behind every book is … not a bookshelf but a team of great people working together to edit, translate, and design the book. My heartfelt thanks to my amazing team of editors, translators, and designers who lost sleep and weight while working on this book.

Elei Zhang
Editor-in-Chief

CHAPTER 1

THE IMMUNE SYSTEM IS OUR SUPERWEAPON

The immune system is a complex network of different organs, tissues, cells, and chemicals that help defend our body against invaders, such as viruses, bacteria, parasites, and other foreign bodies. It works day and night. It is always on duty to defend us against enemies that seek to cause harm.

THE DIFFERENT ORGANS OF THE IMMUNE SYSTEM

Many organs are part of the network that makes up the immune system.

Bone Marrow

The bone marrow produces many of the cells in the blood, including immune cells.

Thymus

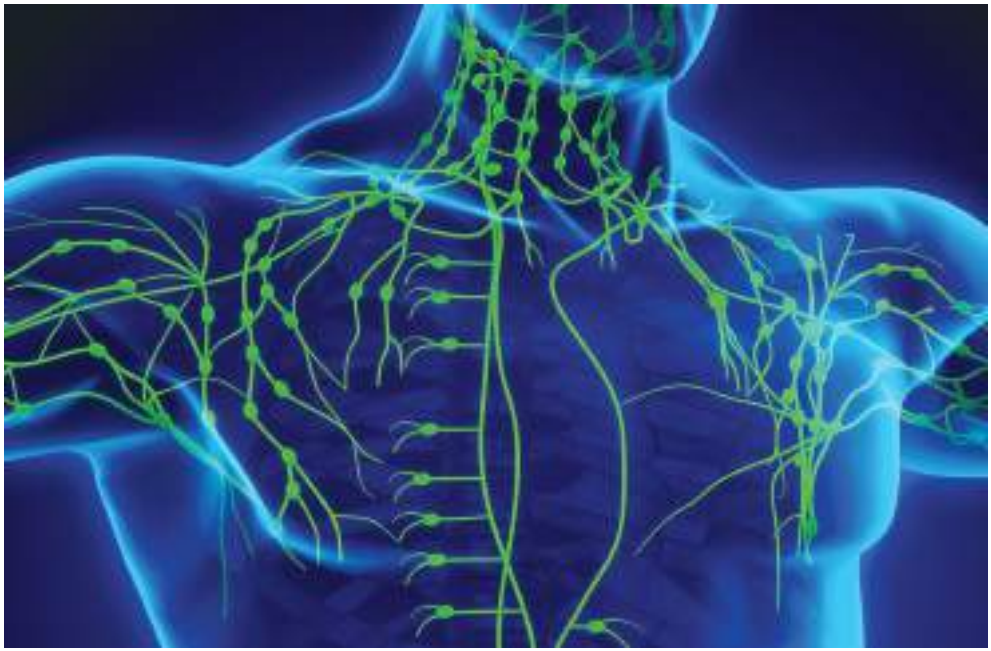
The thymus is like a training ground for immune cell soldiers. Certain types of immature immune cells are sent to the thymus for further maturation and specialization. The thymus is where these soldiers train and learn specialized actions.

Tonsils, Appendix

Many people believe that there are no side effects to having their tonsils or appendix taken out. However, these organs have protective functions for their respective areas. The tonsils help protect against infections in the upper respiratory tract, and the appendix helps protect against infections in the lower gastrointestinal tract.

Spleen

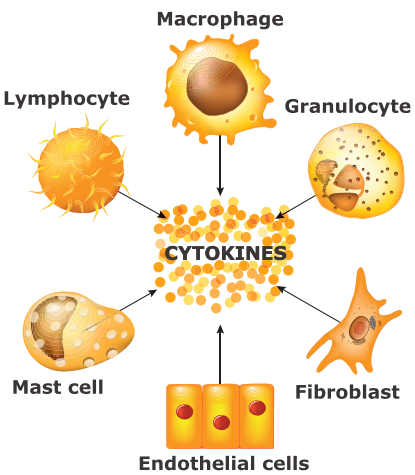
The spleen is another organ we can live without, but not without consequences. The spleen acts a bit like an ammunition production facility. It helps store immune cells, filter blood, and even fight some infections.



Lymph Nodes and the Lymphatic System

The lymphatic system is part of the circulatory system and part of the immune defense. However, instead of transporting blood as blood vessels do, the lymphatic system transports a clear fluid called lymph. As blood is transported throughout the body, fluid from the blood leaks out of the vessels to the surrounding cells as interstitial fluid. This fluid not only carries nutrients to cells, but it also collects and carries away harmful substances, such as waste products and bacteria. It then drains into lymph vessels as lymph. Lymph also carries and transports immune cells to areas of the body where they are needed. While doing so, lymph passes through many lymph nodes. Lymph nodes act as filters and catch materials like bacteria from the lymph. This provides a convenient place for immune cells to target unwanted invaders. Eventually, the lymph will be emptied into veins to be rejoined with blood circulation.

CELLS OF THE IMMUNE SYSTEM



In order to work efficiently, the immune system must be able to effectively differentiate between foreign particles, which may be dangerous, and non-foreign particles, which are safe and are a part of our body. Because the immune system deems non-foreign particles as safe, it allows these particles, such as proteins, cells, and other molecules, to remain in the body, circulate in the blood, and attach to tissues or organs. This is called self-tolerance—the immune system tolerates the presence of these particles. However, the immune system does not tolerate the presence of foreign (non-self) particles, such as those from viruses and bacteria. The presence of such particles triggers the immune system to respond and attack.

Anything that triggers this immune response is called an antigen. Antigens can be the entire bacterium or virus or even just a small part of it. For example, an antigen is like a piece of evidence a detective brings to the police force to launch a raid. An antigen lets the immune system know an enemy is present, so prepare to attack! When the immune system's response is triggered, a variety of cells start preparing to attack and release chemicals called cytokines. Cytokines are used for cell messaging—to communicate between cells. Cytokines notify other cells that the immune response has been triggered and that there is a problem; it is like a call to arms. Cytokines can even direct immune cells to a specific area of the body to help.

The immune system can be split broadly into two parts: the innate immune system and the adaptive immune system (also known as the acquired immune system).

The innate immune system is the one we are born with; it is our foundation. The adaptive immune system is the one we develop and train throughout life. These two systems work closely together.

THE INNATE IMMUNE SYSTEM

The innate immune system is the rapid response system of our body's defense. It responds quickly to initiate an attack when it detects an enemy. The innate immune system is always generalized, meaning that it will attack any and all that it identifies as foreign (non-self).

Physical Barriers

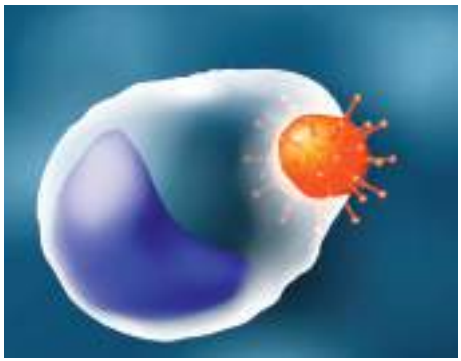
Physical barriers are our first line of defense. They help stop foreign invaders from entering our body, blood, and intercellular spaces (the spaces between cells). Usually, when people think of the immune system, they think only of specialized cells. Body parts and organs do not often come to mind, even though they are part of our immune system. In fact, our very first line of defense is our skin. Our skin is a very effective physical barrier to the outside world.

Apart from our skin, we have many other physical barriers, including our gastrointestinal tract, our respiratory tract, the hairs in our nose and ears, and our eyelashes. The best defense against foreign invaders is to prevent them from invading our body to begin with! Accordingly, our barriers come equipped with defense systems. These defense systems consist of sweat, mucus, gastric acid, saliva, tears, and more. These defenses help wash away and kill foreign invaders before they make it into our body.

If foreign invaders make it past our initial defenses, they will face the cells of our immune system.

CELLS OF THE INNATE IMMUNE SYSTEM

Phagocytes



"Phago" means "to eat" or "to devour." True to their name, phagocytes constantly roam the body hunting for foreign invaders. When they find a pathogen—an organism that can cause disease, such as a virus or bacterium, they will "eat" or engulf the threat and destroy it.

Macrophages

A macrophage is a type of upgraded phagocyte. It can move beyond the walls of blood vessels and patrol for threats. Once it finds a threat, it releases cytokines to tell other immune cells about the problem so that they can come help.

Mast Cells

Mast cells are commonly found in mucous membranes, like those of the respiratory tract. They are important because they are key for initiating the inflammatory response. When activated, they release cytokines that trigger inflammation and call other immune cells to the site of the problem.

Neutrophils

Neutrophils are some of the most prolific types of cells. They are usually the first to arrive at the problem area. Neutrophils contain granules that are very toxic to pathogens. They engulf foreign invaders to destroy them.

Eosinophils

Like neutrophils, eosinophils also contain toxic granules. Eosinophils are especially important for defending against parasites. However, unlike neutrophils, their toxic granules can be released and cause unwanted tissue damage, so eosinophils are tightly controlled by the immune system.

Basophils

Basophils are very similar to eosinophils and neutrophils, but instead of having toxic granules, they release histamine to attack foreign invaders. Histamine is a key player in allergic responses.

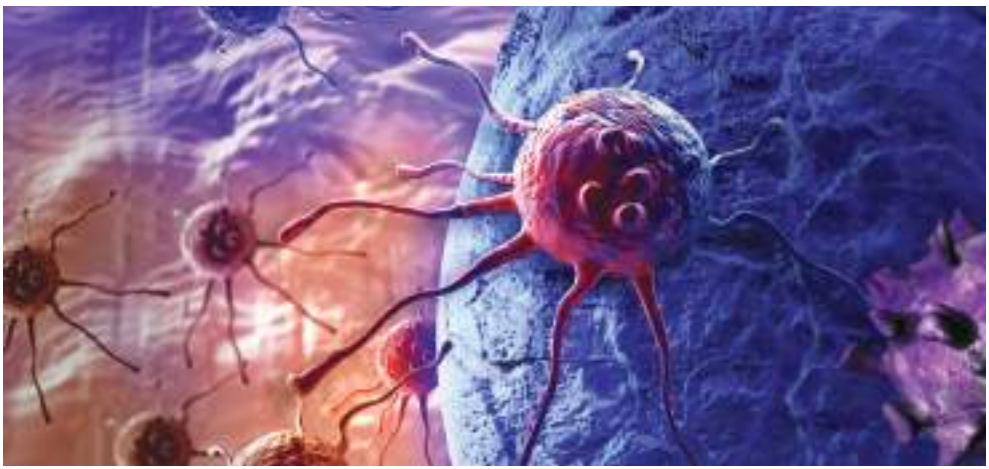
Natural Killer Cells

Natural killer cells do not attack pathogens or foreign invaders. Instead, they monitor our body's cells. If bacteria or viruses infect our body's cells, the natural killer cells will kill the infected cells so they can no longer act as hosts for the invaders. In this way, the bacteria or viruses will have a more difficult time spreading.

Natural killer cells also monitor and detect sick or mutated cells. A mutated cell, such as a cancer cell, is no longer normal, and is dangerous to other surrounding cells. Natural killer cells identify and kill these mutated cells before they become a big problem.

Dendritic Cells

Dendritic cells are messenger cells. They are often in areas of our body that are in contact with the outside world, such as the skin, stomach, intestines, lungs, and the inner lining of the nose. Their specialty is identifying threats and helping coordinate the immune system. They are the link between the innate immune system and the adaptive immune system.



THE ADAPTIVE IMMUNE SYSTEM

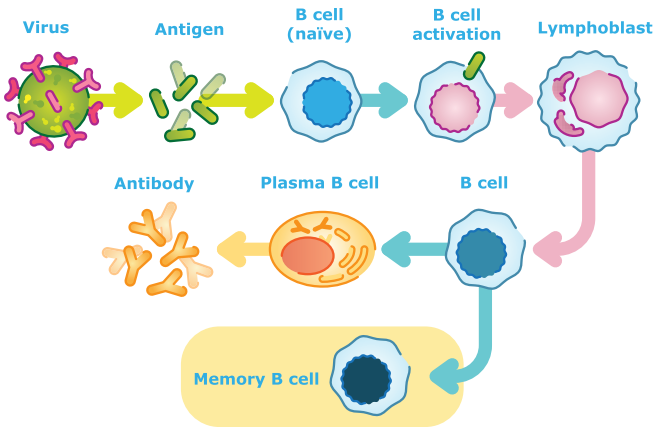
Have you ever wondered why we seem to recover from certain infectious diseases faster and faster once we have had them before? Or why, sometimes, once we get an infectious disease, we will not get it again? Or wonder how vaccinations work? All of this is thanks to the adaptive immune system, also known as acquired immunity. It is the strategic portion of the immune system. We are not born with it; we acquire it. Unlike the innate immune system, this portion of the immune system requires training. When it first meets a pathogen, such as a virus or bacteria, it reacts slower than innate immunity. But, unlike innate immunity, which is generalized, acquired immunity is specific. Once a pathogen triggers the adaptive immune system, the immune system will form a specific attack method against it and will remember this method. The next time the immune system encounters the same pathogen, the response will be both faster and stronger. Oftentimes, the response is so fast and so strong that it gets rid of the foreign invader before we even know it is there. That is how vaccines work—priming the adaptive immune response and forcing it to form a strategic memory. Then, when the immune system meets the real thing, it already has an efficient attack plan in place.

CELLS OF THE ADAPTIVE IMMUNE SYSTEM

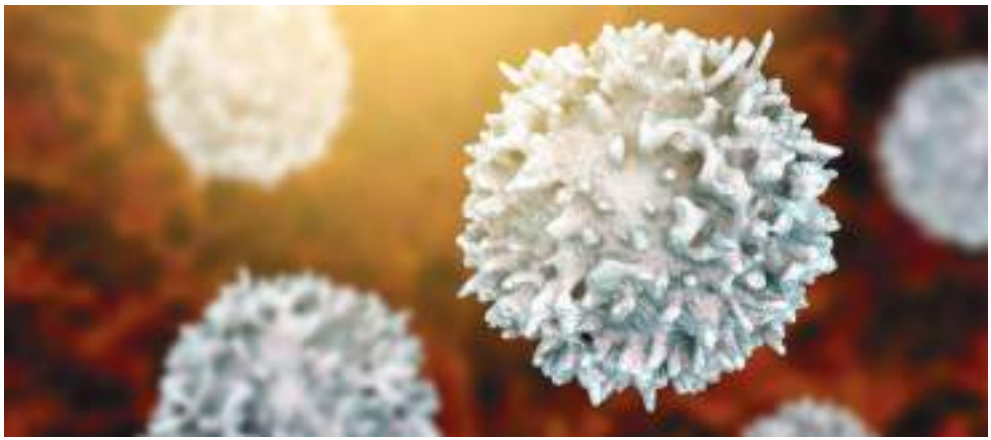
B Cells

B cells form in the bone marrow and then move to the lymphatic system for further maturation and training. B cells have different receptors that bind to different antigens. When the B cell binds to an antigen, the B cell changes, "activates," and divides into two forms: a plasma B cell and a memory B cell.

Plasma B cells produce antibodies targeting specific antigens. These antibodies are like guided missiles—they circulate throughout the body and target specific foreign invaders. Antibodies work in various ways. For example, antibodies may bind themselves to bacteria to make the bacteria's attack ineffective. Some antibodies "glue" together foreign invaders and entice the phagocytes to eat the "glued" chunk. Others trigger chemical cascades that encourage inflammation (so other immune cells come help). Some antibodies even kill foreign invaders by destroying their cell membranes.



Memory B cells can live for a long time and remember the foreign particles that have invaded the body. The next time that same foreign invader is detected, they help the immune system mount a faster response.



T Cells

T cells are formed in the bone marrow, and mature and train in the thymus. They can be split into three general categories.

Helper T cells confirm the presence of a foreign invader by checking the antigens brought by other cells. Once an antigen is confirmed to be from a foreign invader, helper T cells help activate, regulate, and coordinate the immune response.

Cytotoxic T cells kill infected cells and cancer cells.

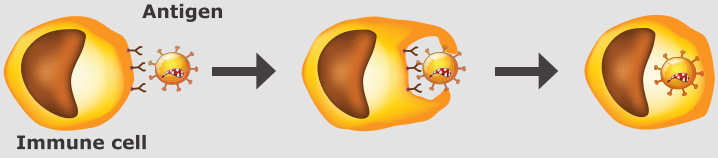
Regulatory T cells help regulate the immune system and maintain self-tolerance. They also halt immune responses, such as inflammation, and tell the immune system when to stop attacking. Thus, they are also known as suppressor T cells.

HOW IT ALL FITS TOGETHER

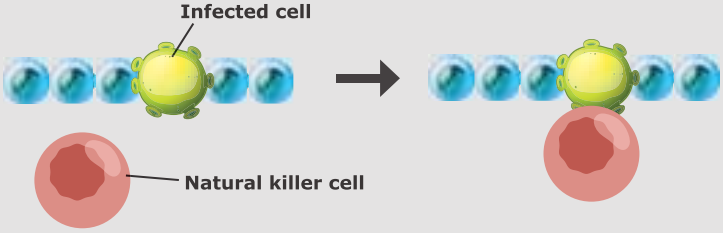
Let us follow a foreign invader, such as bacteria, and see how the different parts of the immune system work together.

1) The bacteria meet physical barriers, such as the skin. Most bacteria cannot get past the skin and so cannot enter our body. The lining of our gastrointestinal tract, the lining of our respiratory tract, the hairs in our nose, and the tears in our eyes are all barriers to help stop bacteria from getting into our body.

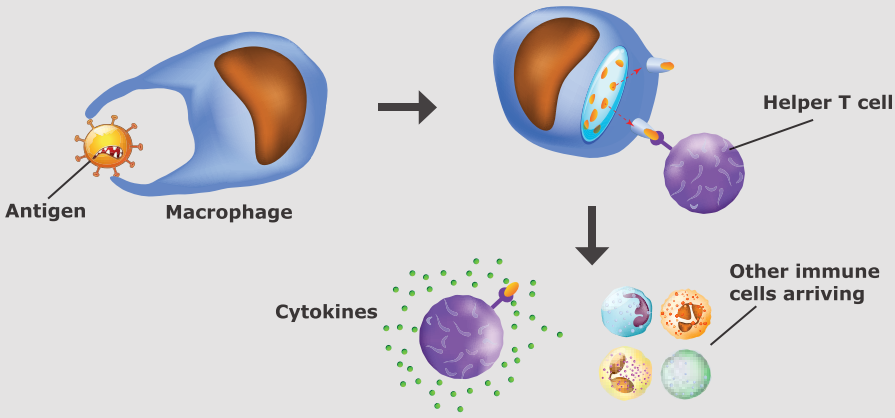
2) If bacteria or viruses get into our system, they meet the cells of the innate immune system. Bacteria and viruses contain antigens, which are substances that provoke an immune response. The immune cells destroy the foreign invaders in various ways, such as through phagocytosis ("eating") and by releasing cytokines that call in other cells and act as a trigger for other methods of help.



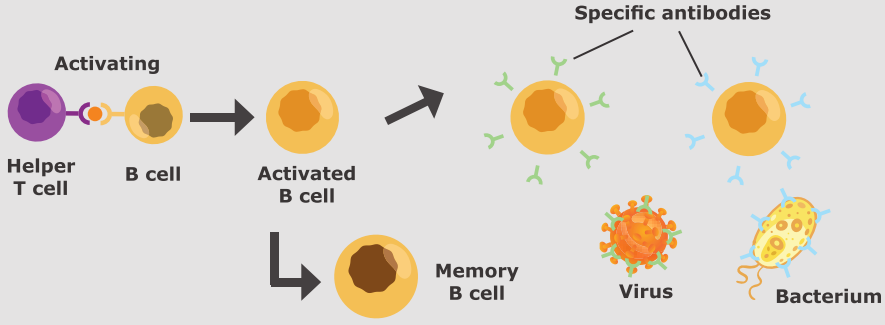
If a cell becomes infected with a virus or mutated, the natural killer cell can identify and kill it.



3) Certain cells of the innate immune system take an antigen and present it to cells of the adaptive immune system, such as the helper T cell. The helper T cell releases cytokines that call other cells to action.



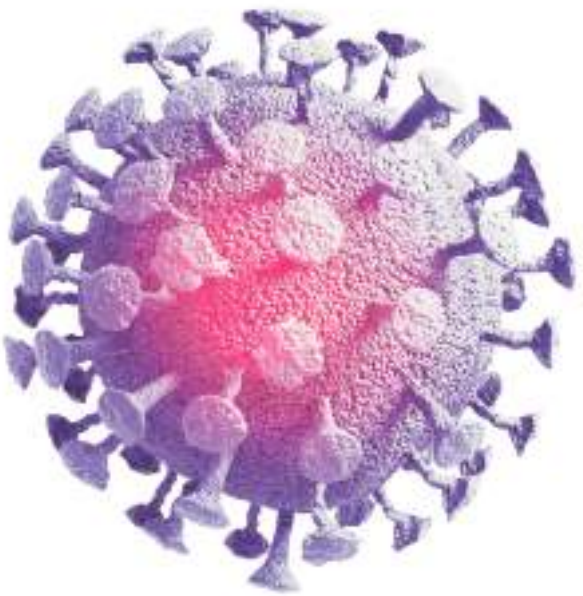
For example, helper T cells help activate B cells. B cells can produce antibodies that are specific to the foreign invader. These antibodies destroy the foreign invader. Some B cells also form a memory and become memory B cells. Memory B cells live in the body for a long time, giving us immunity to a particular invader. The next time we encounter the same foreign invader, these memory B cells will alert the immune system and trigger a faster response.



4) Once everything is done, and the threat has been dealt with, the immune system stops the attack.

WHAT HAPPENS WHEN IT ALL GOES WRONG

Modern scientific capabilities have profoundly altered the course of life. People are living longer and better than at any other point in history. Scientific advances have turned the process of aging and illness into medical experiences, all to be handled by medical professionals.



We live under the belief that doctors can cure almost anything. We believe our medical technology is advanced enough to bring us back from the brink of death. In reality, we cannot cure most illnesses, such as most genetic diseases, autoimmune diseases, and allergies. Scientists cannot even cure the common cold. A runny nose, scratchy throat, and constant sneezing—the symptoms of the common cold—are hard to miss. But in spite of this all-too-recognizable illness, it is still shrouded in mystery. Why do some people never seem to catch the cold while some always do? Most importantly, how can we stay healthy all the time and not catch it at all?

Take a look at the pandemics that have swept the world. In fact, there was one recently—COVID-19. COVID-19 was a new coronavirus, and the scientific community raced to develop a vaccine for it. In other words, scientists were trying to stimulate our immune system to defend us better so our body could fight off the virus before getting sick. A strong immune system can get rid of the coronavirus. A weak immune system might need more time to fight the virus or might not be able to fight it at all. Currently, the treatments doctors give patients are those that help them stay alive long enough for their immune systems to do their jobs, and hopefully, their immune systems will be able to fight off the virus. This is the case with other viral infections as well. Like in previous pandemics, some people die, while others survive. The survivors are the ones with strong and fully functioning immune systems, while the victims have complications in their immune responses.

We cannot always rely on doctors, scientists, and researchers to fix us. Often, when we are sick, the best they can do is suppress our symptoms so that we feel better. However, that does not get rid of the disease. In the end, we must rely on our immune system. Our immune system has the ability to get rid of and even prevent disease, but its effectiveness depends on how healthy and functional it is. If our immune system is not working right, we are going to have some serious problems coming our way.

For example, if we catch a viral infection, it might trigger a cytokine storm. A cytokine storm is due to a malfunctioning immune system (not a strong immune system as many people think). The immune system is broken, and the immune cells do not know when to stop attacking. If the immune system continues to attack unnecessarily, it will cause a lot of collateral damage to the body's tissues, much like a weapon that shoots aimlessly even after the war has ended. Various illnesses can trigger a cytokine storm, but scientists do not know exactly what triggers it, nor do they know the best way to treat it or cure it.

Autoimmune disease is another type of illness that occurs when the immune system malfunctions. The immune system has the ability to differentiate between friend (the body's tissues and cells) and foe (a foreign invader). An autoimmune disease occurs when this ability is impaired; the immune system gets confused and starts attacking the body's tissues and cells. For example, rheumatoid arthritis happens when the immune system starts attacking the body's joints, causing pain and swelling. Psoriasis happens when the immune system attacks the skin, causing skin plaques.